

WHAT IS CLAIMED:

1. A method for forming a gate oxide film in an integrated circuit device comprising:  
5 forming a gate oxide film on a substrate on an active region adjacent to a trench isolation region in a first gas atmosphere with a first amount of chloride; and  
annealing the gate oxide film in a second gas atmosphere including a second amount of chloride that is greater than the first amount of chloride.
- 10 2. The method according to Claim 1 wherein the gate oxide film comprises a first gate oxide film and the active region comprises a first active region in a cell region of the integrated circuit device, the method further comprising the step of:  
forming a second gate oxide film on a second active area of the substrate in a  
15 peripheral region of the integrated circuit device spaced apart from the first active area in a second gas atmosphere with the second amount of chloride.
3. The method according to Claim 1 wherein the first amount of chloride comprises substantially no chloride.  
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4. The method according to Claim 1 wherein the first gate oxide film comprises a first thickness, the method further comprising:  
reducing the first thickness of the first gate oxide film;  
performing an oxidization process on the substrate spaced apart from the first  
25 gate oxide film using a third gas including chloride to form a second gate oxide film to a second thickness and to thicken the first gate oxide film to a third thickness that is greater than the second thickness.
5. The method according to Claim 1 wherein the first gas comprises at  
30 least one of O<sub>2</sub> gas, O<sub>2</sub>/N<sub>2</sub> gas, O<sub>2</sub>/N<sub>2</sub>O gas and O<sub>2</sub>/NO gas.
6. The method according to Claim 5 wherein the step of forming a gate oxide film comprises forming the gate oxide film a temperature in a range between about 780°C and about 900°C.

7. The method according to Claim 1 wherein the first gas comprises at least one of  $H_2/O_2$  gas or  $H_2O$  gas.
- 5 8. The method according to Claim 7 wherein the step of forming a gate oxide film comprises forming the gate oxide film at a temperature in a range between about  $780^{\circ}C$  and about  $850^{\circ}C$ .
9. The method according to Claim 1 wherein a ratio between a first  
10 thickness of portion of the gate oxide film located on a central portion of the active region and a second thickness of a portion of the gate oxide film located at an edge portion of the active region is in a range between about 1:1 and about 1:1.5.
10. The method according to Claim 1 wherein the second gas includes at  
15 least one selected from the group consisting of  $HCl$ ,  $Cl_2$ ,  $C_2HCl_3$ ,  $CH_2Cl_2$ , and  $C_2H_3Cl_3$ .
11. The method according to Claim 1 wherein the step of annealing comprises annealing the first gate oxide film using a furnace or by performing a rapid  
20 thermal annealing process.
12. The method according to Claim 1 wherein the gate oxide film is annealed at a temperature in a range between about  $850^{\circ}C$  and about  $900^{\circ}C$ .
- 25 13. The method according to Claim 1 wherein the step of forming and annealing are performed *in-situ*.
14. A method for forming a gate oxide film in a integrated circuit device comprising:  
30 forming a first gate oxide film having a first thickness on a integrated circuit substrate where an active region is defined by a trench isolation region having a liner formed on an inner sidewall of a trench wherein the first gate oxide film is formed by an oxidization process in a first gas atmosphere without chloride;

annealing the first gate oxide film in a second gas atmosphere including chloride;

forming a pattern on the integrated circuit substrate wherein the pattern exposes a first region of the integrated circuit substrate where a thin gate oxide film is  
5 formed;

removing a portion of the first gate oxide film from the first region using the pattern as an etching mask;

removing the pattern; and

forming a second gate oxide film having a second thickness that is less than  
10 the first thickness on the first gate oxide film and on the first region by an oxidization process using a third gas atmosphere.

15 15. The method according to Claim 14 wherein the first gas includes at least one selected from the group consisting of O<sub>2</sub> gas, O<sub>2</sub>/N<sub>2</sub> gas, O<sub>2</sub>/N<sub>2</sub>O gas and O<sub>2</sub>/NO gas.

16. The method according to Claim 15 wherein the first gate oxide film is formed at a temperature of approximately 780 to 900°C.

20 17. The method according to Claim 14 wherein the first gas includes H<sub>2</sub>/O<sub>2</sub> gas or H<sub>2</sub>O gas.

18. The method according to Claim 17 wherein the first gate oxide film is formed at a temperature of approximately 780 to 850°C.

25 19. The method according to Claim 14 wherein a thickness ratio between a portion of the first gate oxide film at a central portion of the active region and a portion of the first gate oxide film at an edge portion of the active region is approximately 1:1 to 1:1.5.

30 20. The method according to Claim 14 wherein the second gas includes at least one selected from the group consisting of HCl, Cl<sub>2</sub>, C<sub>2</sub>HCl<sub>3</sub>, CH<sub>2</sub>Cl<sub>2</sub>, and C<sub>2</sub>H<sub>3</sub>Cl<sub>3</sub>.

21. The method according to Claim 14 wherein the first gate oxide film is annealed using a furnace or by a rapid thermal annealing process.

22. The method according to Claim 14 wherein the first gate oxide film is  
5 annealed at a temperature of approximately 850 to 900°C.

23. The method according to Claim 14 wherein forming the gate oxide film and annealing the first gate oxide film are performed *in-situ*.

10 24. The method according to Claim 14 wherein the second gate oxide film is formed in the third gas atmosphere without chloride.

25. The method according to Claim 24 wherein the third gas includes at least one selected from the group consisting of O<sub>2</sub> gas, O<sub>2</sub>/N<sub>2</sub> gas, O<sub>2</sub>/N<sub>2</sub>O gas and  
15 O<sub>2</sub>/NO gas.

26. The according to Claim 24 wherein the third gas includes H<sub>2</sub>/O<sub>2</sub> gas or H<sub>2</sub>O gas.

20 27. The method according to Claim 24 further comprising:  
annealing the second gate oxide film in a fourth gas atmosphere including chloride.

28. The method according to Claim 27 wherein the fourth gas includes at  
25 least one selected from the group consisting of HCl, Cl<sub>2</sub>, C<sub>2</sub>HCl<sub>3</sub>, CH<sub>2</sub>Cl<sub>2</sub>, and C<sub>2</sub>H<sub>3</sub>Cl<sub>3</sub>.

29. The method according to Claim 27 wherein forming the second gate oxide film and annealing the second gate oxide film are performed *in-situ*.

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